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THE MELANOCYTES OF THE INTERNAL EAR (I MELANOCITI DELL'ORECCHIO--ETC(U)
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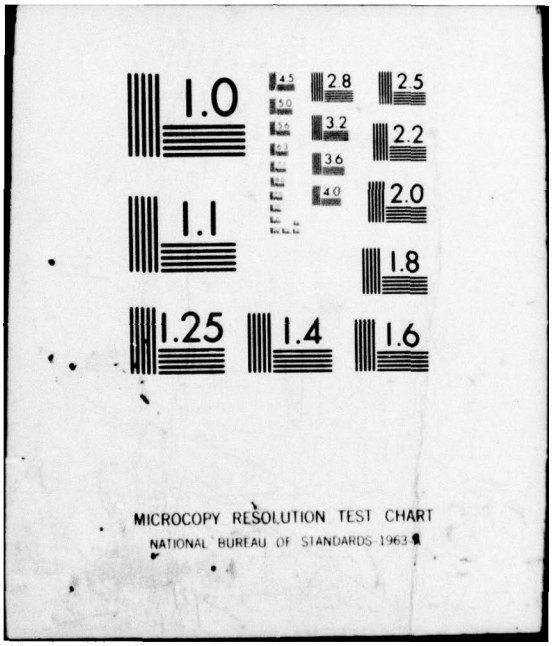
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AMERICAN REVOLUTION BICENTENNIAL 1776-1976

THE MELANOCYTES OF THE INTERNAL EAR

/20*

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In the extensive bibliography on the normal and pathological biology of the pigmented elements of the melanogenetic series, there is almost a total lack of reference to their existence in the internal ear. The only exception, as far as I know, regards a schematic diagram made by Fitzpatrick, et al. in 1961 [1] on the distribution of melanocytes in man without, furthermore, any other reference being made in the text. Likewise, nothing was found in the examination of contributions from various authors to congresses and various international conferences concerning pigmented cells. We are especially grateful to Professor Giordano, who desired this symposium, for having provided me the possibility for presenting part of the laboratory research on cellular elements of the acoustic and vestibulary labyrinth of various animal species, which has been carried out in the Laboratory of Intravital Microcirculation of the Clinic under my direction.

The presence of dark, free or intracellular pigment in a number of sectors of the internal ear has, on the other hand, been well known for some time. This did not pass unnoticed as early as a century ago when Alfonso Corti gave his marvelous description of the auditory organ which he discovered and which bears his name. Since that time, although the studies have not been numerous, researchers in the pure histology of the membranous labyrinth have provided contributions both toward establishing whether the pigment is a normal, paraphysiological or pathological product as well as toward ascertaining its chemical nature. Others have shown the way to a more precise identification of the pigmented cellular elements and considered then as merely pigment-carrying elements. Only a very few researchers, and among them our Catalano and Madonia [1964, 2] have maintained that the pigment should be melanic and that the cells containing it, on the basis of ontogenetic and phylogenetic considerations, are melanocytes.

The opinions, although subject to doubt and controversy, were at this point when we [1964, 3-4] in the course of research on the labyrinthine microcirculation in living animals (guinea pigs) noted that the stria vascularis of the membranous labyrinth of the albino was completely lacking in pigment whereas, on the other hand, the stria was profusely disseminated in animals with colored fur or with a white fur and dark irises. Successive research [1965, 5] allowed describing a special behavior of the pigmented cellular elements as a result of various stimuli (light, darkness, industrial noise, sonic trauma, etc.). More detailed investigations [1966, 6] were carried out involving intravital research on guinea pigs and frogs and allowed indentifying morphological variations of the pigmented elements with their dynamic functional variants.

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*Numbers in the right margin indicate pagination in the original text.

**Atti. Acad. Med. Lomb., 23:20, 1968.

As far as we were concerned, we were already in possession during those years of sufficient experimental data to be persuaded that the pigmented elements were to be attributed to the melanogenetic series and that the pigment was melanin. It then appeared absolutely necessary to complete the research either by cellular stimulation with hormones or melanoactive drugs or by means of studying the ultrastructure.

The first investigation has now been reported and its results were presented to the Fourth European Conference on Microcirculation held at Cambridge [1966, 7-8a,b] and was performed on the labyrinth of frogs and guinea pigs. The labyrinth was laid bare by means of special techniques, subjecting the animals in the experiment alternately and at suitable intervals of time to doses of antithetic hormones of the intermediate pituitary gland (MSH) and of the pineal gland (melatonin). Another group of animals was treated with serotonin as well as with 5-methoxy tryptophol. The MSH and the serotonin, as stated above, on specific species of the lower vertebrates produced the so-called "darkening effect" owing to the dispersion of grains of melanin in the melanophores whereas the melatonin and the 5-methoxy tryptophol gave the "lightening" effect. Both of these phenomena formed the basis for mimetism. /21

The results of the hormonal tests which I am reporting in summary form were positive. In frogs, the melatonin and the intermedin (MSH) demonstrated their opposite action on the pigmented cells of the internal ear, pia and dura mater as well as the outer layer cortex. Melatonin caused a contraction of the cellular elements and a consequent paling of the mantle of the animals. Intermedin caused cellular expansion in various areas examined with a simultaneous surface chromatic accentuation. The serotonin gave results similar to those of intermedin and the 5-methoxy tryptophol induced cellular contractions just like melatonin. In guinea pigs, the clearest response, limited to the pigmented cells of the inner ear (semicircular canals) occurred with serotonin and intermedin. p. 4

The data now reported (after prior testing) were checked during the ultrastructural investigation [1966, 8] either of the labyrinth of frogs, guinea pigs or monkeys (Macacus rhesus). The fact that we were able to identify in the cytoplasm of the pigmented cellular elements of all three species of animals the various cycles of differentiation of the grain of melanin of the melanoblast, the ribosomic system with the premelanosome as well as the mature melanosome, constitutes, in our opinion, the most modern documentary possibility for confirming our conclusions.

The various stages of our experimental research which has been conducted together with histological studies of the human labyrinth [1965, 9] and using clinical and audiological observations [1965, 10] have allowed us not only to deduce, as we have stated, that the pigmented cells of the acoustic and vestibulary labyrinth should even in human beings be considered as belonging to the melanogenetic series but also to set forth a number of functional hypotheses concerning the melanin of the internal ear to which could not be attributed without further proof either the mimetic function limited to animals which are provided with mimetic capability or the functional absolute inertia for the higher vertebrates and for man.

In the meantime, by means of electrophysiological research, my collaborators have shown a relationship between resistance to sonic shock and acoustic fatigue and the degree of pigmentation of the membranous acoustic labyrinth [1965, 10] in the sense of a major reduction in the amplitude of the cochlear potentials and of a longer period of recovery in albino guinea pigs with respect to colored ones. However, research has proceeded further showing exclusively by means of electrophysiological studies an equal varying behavior with the derivation of the cochlear potentials between animals with clear irises and dark mantle and guinea pigs with dark irises and clear mantle. These observations supplemented by preceding clinical and histological research have made plausible the hypotheses stating that the degree of pigmentation of the acoustic labyrinth is in relationship more with the color of the iris than with the cutaneous mantle.

As a result, it has been agreed to consider that in man, too, visual acuity and acoustic power are correlated to the degree of melanic pigmentation. The color of the iris should constitute an element of considerable clinical importance [1965, 11] in addition to the cutaneous mantle provided with melanocytes for stabilizing, in an inductive way, the degree of pigmentation of the acoustic labyrinth. This should also appear at first sight to be an inference or presumption of little importance if it were not for the very recent observations of a student of audiology named Rosen [1967, 12] who encountered in a Negro tribe a marked increase in auditory acuity and a wider range of audible frequencies. However, still more recent clinical investigations carried out by the Otological and Ophthalmological School of the University of Pisa [1967, 13] carried out on young subjects concerning the relationship existing between colors of the iris and fatigue of the sense of hearing have confirmed the hypotheses recently reported concerning the protective function exerted by melanin against acoustic shocks by confirming that the resistance to auditory fatigue is directly proportional to the concentration of this pigment in the iris. It is not possible to ignore the importance to the medical-social aspects as well as to preventive medicine of this fact. The color of the iris, meaning by this the pigmentation of the acoustic labyrinth, would allow a priori individualization of the greater or lesser sensitivity of the cochlear organ in comparisons of intense and prolonged acoustic stimuli. Obviously, the observation has no value if it is done on newborn infants whose irises are always blue in color in the Indo-European race owing to the lack at birth of the melanic pigment of the iris. However, we could not support the clinical confirmation on the hypotheses issued on the basis of all experimental and electrophysiological observations on which we have spent some time. /22

The results which we achieved are therefore as follows. We have given the intravital demonstration of the melanokinetic response of pigmented elements of the membranous labyrinth of the Rana esculenta (edible frog) and the guinea pig. We have studied, using the electronic microscope, the pigmented cellular elements in monkeys confirming the ultrastructure of the melanogenetic cells. We have demonstrated using high-speed photography and the ultrastructure, that the mimetic phenomenon or better the morphological variation of the so-called contractile melanocytes is not owing to the perinuclear aggregation or to the dispersion of grains of melanin in the static cellular body of the melanocyte, but rather to

variations in the spatial dimensions of the cell. We have shown the relationship between the color of the iris and the concentration of melanin in the internal ear and finally the various functional hypotheses on the grain of melanin which will shortly be more amply discussed.

SUMMARY

The results of research on the cellular pigments on the internal ear are presented.

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